

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

HARREUS et al.

Serial No. 08/776,578

Filed: February 2, 1997

For: PREPARATION OF O-(2-HYDROXYALKYL)OXIMES

Art Unit: 1621

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Honorable Commissioner of  
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RESPONSE UNDER 37 CFR 1.111

Sir:

The examiner is requested to favorably reconsider the rejections under 35 U.S.C. 102(a& f) and 103(a) as being unpatentable over Blaser considered alone or in view of ancillary references. The rejections were made pending the submission of a certified translation of the applicants' priority document. A a certified translation of the applicants' priority document is submitted herewith. A Notice of Allowance is solicited.

Please charge any shortage in fees due in connection with the filing of this paper, including Extension of Time fees to Deposit Account No. 11.0345. Please credit any excess fees to such deposit account.

Respectfully submitted,

KEIL & WEINKAUF

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**VERIFICATION OF A TRANSLATION**

I, the translator named below, hereby declare that:

My name and post office address are as stated below;

I am knowledgeable in the German language, in which the

**German Priority Document P 44 27 289.8**  
was issued by the German Patent Office on  
12th June, 1995,


and I believe the attached document in the English language to be a true and complete translation of said German Priority Document.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardize the validity of the patent application issued thereon.

Signed this twentieth day of July, 1998



**CERTIFIED COPY OF  
PRIORITY DOCUMENT**



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[TRANSLATION FROM GERMAN]

**FEDERAL REPUBLIC OF GERMANY**

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**CERTIFICATE**

BASF Aktiengesellschaft of 67056 Ludwigshafen lodged with the German Patent Office an application for a patent of invention entitled:

"Process for the Preparation of O-(2-hydroxyalkyl) Oximes"

on 2nd August, 1994.

The attached document is a true and accurate copy of the original specification of this application for patent.

The German Patent Office has provisionally accorded the application the symbols C 07 C 251/54 and C 07 C 249/12 of the International Patent Classification.

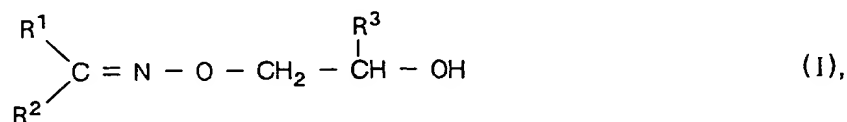
L.S.

Munich, June 12, 1995  
The President of the German Patent Office  
by proxy  
(sgd) Schulenburg

File No.: P 44 27 289.8

## Claims

A process for the preparation of *O*-(2-hydroxyalkyl) oximes of the general formula I



in which  $\text{R}^1$  and  $\text{R}^2$  stand for alkyl groups having from 1 to 10 carbon atoms or alternatively form, together with the carbon atom to which they are attached, a 5-membered to 7-membered cycloalkyl radical, and  $\text{R}^3$  denotes an alkyl group having from 1 to 10 carbon atoms, wherein a ketoxime of the general formula II



is caused to react

a) with an olefin oxide of the general formula III



in the presence of a tertiary amine or

b) with a carbonate of the general formula IV



in the presence of a catalyst.

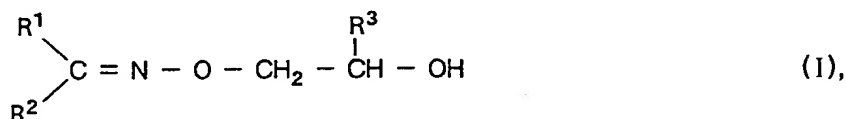
2. A process as defined in claim 1, wherein the ketoxime II used is acetone oxime, butanone oxime, or cyclohexanone oxime.

3. A process as defined in claim 1 or claim 2, wherein the ketoxime II used is acetone oxime.
4. A process as defined in any of claims 1 to 3, wherein the starting material is a compound III or IV in which  $R^3$  denotes methyl.
5. A process as defined in any of claims 1 to 4, wherein triethylamine is used as catalyst in process variant (a).
- 10 6. A process as defined in any of claims 1 to 4, wherein *N,N*-dimethylcyclohexylamine is used as catalyst in process variant (a).
7. A process as defined in any of claims 1 to 5, wherein the catalyst used in process variant (b) is potassium fluoride.
8. A process as defined in any of claims 1 to 7, wherein potassium hydrogen carbonate is used as catalyst in process variant (b).

# Process for The Preparation of O-(2-hydroxyalkyl) Oximes

## Description

The present invention relates to a process for the preparation of O-(2-hydroxyalkyl)oximes of the general formula I



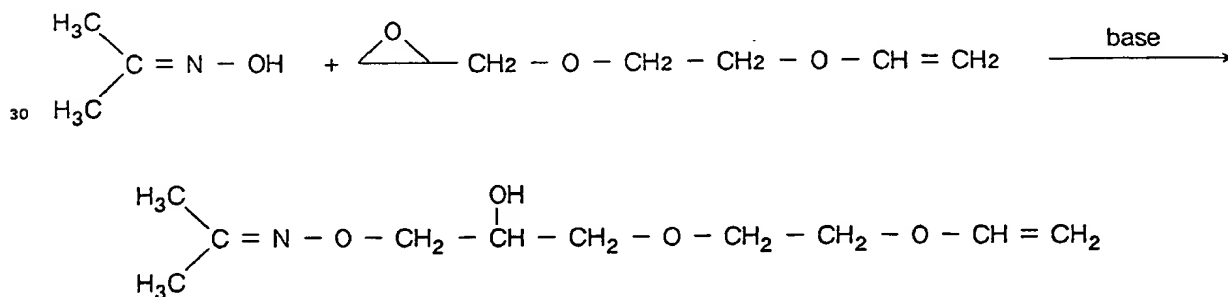
in which R<sup>1</sup> and R<sup>2</sup> stand for alkyl groups having from 1 to 10 carbon atoms, where R<sup>1</sup> and R<sup>2</sup> can alternatively form, together with the carbon atom to which they are attached, a 5-membered to 7-membered cycloalkyl radical, and R<sup>3</sup> denotes an alkyl group having from 1 to 10 carbon atoms.

O-(2-hydroxyalkyl)oximes have great significance as intermediates for plant protectants (*cf, eg, the prior German Application P 44 15 887.4*).

*J. Amer. Chem. Soc.* 81 pp 4223 to 4225 (1959) and *US-A* 3,040,097 describe a process for the preparation of O-(2-hydroxyalkyl)oximes in which the parent oximes are caused to react with olefin oxides under basic conditions, in particular in the presence of alkali metal bases.

*PL-A* 53,525 (*Chemical Abstracts* 68 49175d (1968)) reveals that tertiary amines are suitable bases for a similar case.

Specially substituted O-hydroxyalkyloximes can be prepared by the reaction of glycol vinyl glycidyl ethers with oximes in the presence of bases such as triethylamine or potassium hydroxide, for example.



Furthermore, it is well known that it is possible to cause reaction of acetone oxime with ethylene carbonate in toluene in the presence of potassium fluoride to

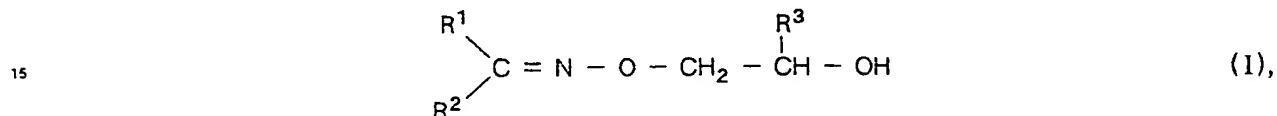
produce *O*-(2-hydroxyethyl)acetone oxime (cf *Amer. Chem. Soc. Symposium Series* 443 page 231 (1991)).

Furthermore, a process for the preparation of bis[*O*-(2-hydroxyethyl)]dimethylglyoxime starting from dimethylglyoxime and ethylene carbonate is described in *J. Polymer Sci.* 10 page 3408 (1972).

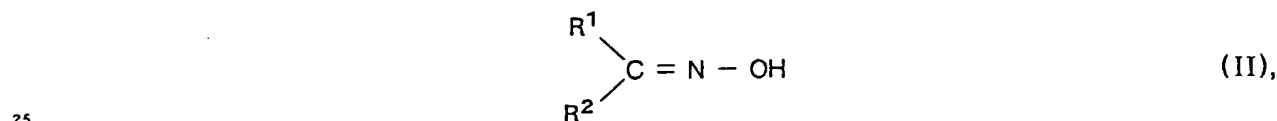
It was the object of the invention to provide a more economical process for the preparation of *O*-(2-hydroxyalkyl)oximes of the type designated by I.

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Accordingly, we have found a process for the preparation of *O*-(2-hydroxyalkyl)oximes of the general formula I



in which  $\text{R}^1$  and  $\text{R}^2$  stand for alkyl groups having from 1 to 10 carbon atoms or alternatively form, together with the carbon atom to which they are attached, a 5-  
20 membered to 7-membered cycloalkyl radical, and  $\text{R}^3$  denotes an alkyl group having from 1 to 10 carbon atoms, wherein a ketoxime of the general formula II



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is caused to react

a) with an olefin oxide of the general formula III

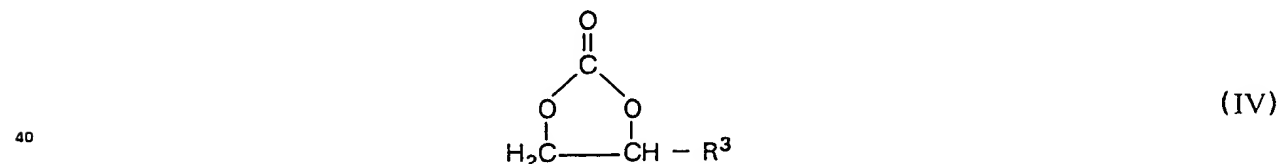
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in the presence of a tertiary amine or

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b) with a carbonate of the general formula IV



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in the presence of a catalyst.

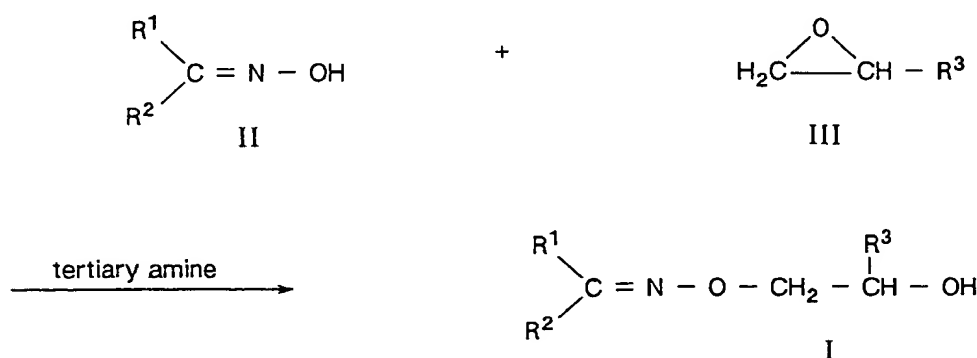
The following literature citations "Houben-Weyl" refer to Houben-Weyl, *Methoden der Organischen Chemie*, 4th Edition, Thieme Verlag, Stuttgart.

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Process variant (a)

In the process variant (a) the ketoximes II are caused to react with olefin oxides III in the presence of a tertiary amine for preparation of the O-(2-hydroxyalkyl)oximes I:

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Of the compounds I which can be produced by this process variant those are preferred in which R<sup>1</sup> and R<sup>2</sup> stand for C<sub>1</sub>-C<sub>4</sub> alkyl groups and primarily C<sub>1</sub>-C<sub>3</sub> alkyl groups or form, together with the carbon atom to which they are attached, a cyclopentyl or cyclohexyl ring, and in particular those in which R<sup>1</sup> and R<sup>2</sup> stand for methyl and/or ethyl or form, together with the carbon atom to which they are attached, cyclohexyl. R<sup>3</sup> preferably stands for a C<sub>1</sub>-C<sub>4</sub> alkyl group, particularly for ethyl and more particularly for methyl. Most particularly preferred compounds I are those in which R<sup>1</sup>, R<sup>2</sup> and R<sup>3</sup> stand for methyl.

The ketoximes II are generally known or are obtainable by known methods, for example, by the reaction of the corresponding ketones with hydroxylamine.

The olefin oxides III are also generally known or are obtainable by known methods.

35

The molar ratio of olefin oxide III to ketoxime II is preferably from 1:1 to 2:1 and in particular from 1.1:1 to 1.3:1.

Suitable tertiary amines, either alone or in the form of a mixture, are primarily those having aliphatic and/or cycloaliphatic groups on the N atom such as



triethylamine, tri-*n*-propylamine, tri-*n*-butylamine, tri-*n*-octylamine, tri-*n*-dodecylamine, *N*-methyldicyclohexylamine, and *N,N*-dimethylcyclohexylamine and also heterocyclic nitrogen bases having from 5 to 10 carbon atoms such as pyridine, 4-(*N,N*-dimethylamino)pyridine, 1,8-diazabicyclo[5.4.0]undec-7-ene, 1,4-diazabicyclo[2.2.2]octane, and 1-methylimidazole.

Preferably, with regard to the fact that the reaction mixture present at the end of the reaction is to be subjected to purification by distillation, a tertiary aliphatic amine is used, the boiling point of which is between 50° and 250°C and in particular between 80° and 180°C, primarily triethylamine and *N,N*-dimethylcyclohexylamine.

The tertiary amine is usually employed in an amount of from 0.5 to 40 mol%, preferably from 0.9 to 10 mol% and more preferably from 1 to 5 mol%, based on the ketoxime II.

The reaction can be carried out without the use of solvent or in a suitable solvent or solvent mixture.

Suitable solvents are alkanols such as ethanol and *tert*-butanol, ethers such as 1,4-dioxane and tetrahydrofuran, ketones such as acetone, esters such as ethyl acetate, nitriles such as acetonitrile, *N,N*-dialkylamides such as dimethyl formamide and *N,N*-dimethylacetamide, *N*-alkylated lactams such as *N*-methyl-2-pyrrolidone, and *N,N*-dialkylated cyclic ureas such as *N,N*-dimethylethylene urea and *N,N*-dimethylpropylene urea.

Of said solvents the *N,N*-dialkylamides and *N*-alkylated lactams are preferred, and dimethyl formamide and *N*-methyl-2-pyrrolidone are particularly preferred.

Furthermore, from a process engineering point of view, those of the aforementioned solvents are preferred, broadly speaking, which have a similar boiling point to that of the amines used and/or form azeotropes with them such that their removal, by distillation, from the crude reaction mixture takes place in a particularly simple manner.

Also suitable as solvent is an excess of one of the aforementioned tertiary amines which is in the liquid state at least under the reaction conditions.

There are usually employed from 50 to 500 mL and preferably from 50 to 200 mL of solvent, based on 1 mol of the ketoxime II.

The reaction is carried out at temperatures of from 40° to 130°C and mostly from 70° to 110°C and pressures of from 0.5 to 40 bar and mainly from standard pressure to 20 bar.

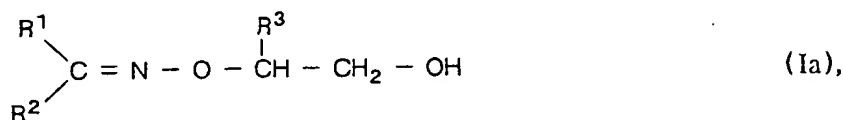
5 The reaction times are normally from 2 to 24 h but mostly from 4 to 16 h.

Preferably the process is carried out by placing the ketoxime II and the tertiary amine, optionally in a solvent, in the reactor and metering in the olefin oxide III at the temperature of reaction.

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The isolation of the reaction products I takes place by methods known *per se*, preferably by distillation.

15 A by-product frequently obtained during the reaction is the regioisomeric compound Ia

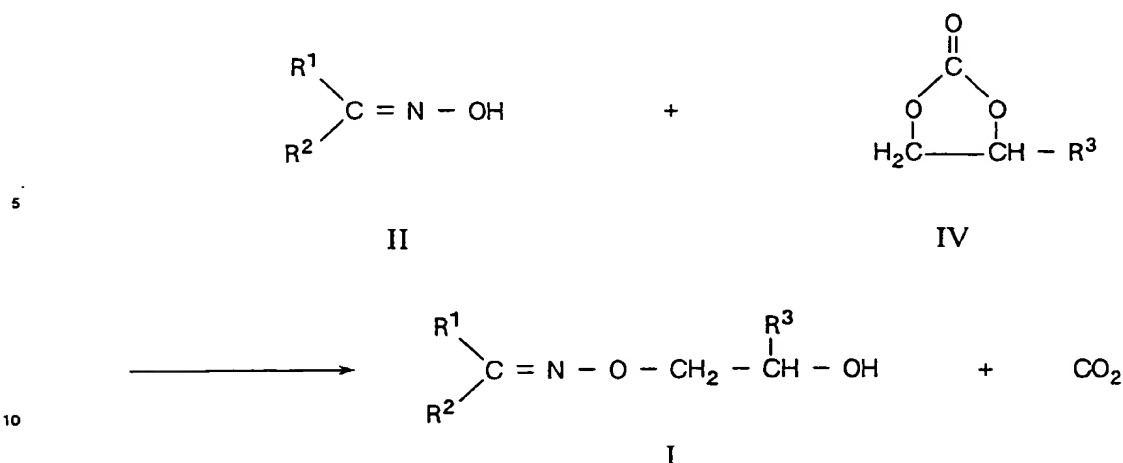


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usually in amounts of up to 10 % based on I. The two isomeric compounds I and Ia are usually the first overheads occurring during distillation of the crude product. If desired, the isomer Ia, which is undesirable for some applications, can be separated to a major extent from the compound I by methods known *per se*,  
25 preferably by fractional distillation.

#### Process variant (b)

When preparing the O-(2-hydroxyalkyl)oximes I by the process variant (b) the  
30 ketoximes II are caused to react, in the presence of catalysts, with carbonates IV:



Among the compounds I which can be produced by this process variant those are preferred in which R<sup>1</sup> and R<sup>2</sup> stand for C<sub>1</sub>-C<sub>4</sub> alkyl groups primarily C<sub>1</sub>-C<sub>3</sub> alkyl groups or form, together with the carbon atom to which they are attached, a cyclopentyl or cyclohexyl ring, and in particular those in which R<sup>1</sup> and R<sup>2</sup> stand for methyl and/or ethyl or form, together with the carbon atom to which they are attached, cyclohexyl. R<sup>3</sup> preferably stands for a C<sub>1</sub>-C<sub>4</sub> alkyl group, particularly for ethyl and more particularly for methyl. Compounds I are mostly preferred in which R<sup>1</sup>, R<sup>2</sup> and R<sup>3</sup> stand for methyl.

The carbonates IV are generally known or can be produced by known methods, (cf, eg, EP-A 543,249).

The molar ratio of carbonate IV to ketoxime II is usually from 1:1 to 10:1 and in particular from 4:1 to 7:1.

Suitable catalysts, used either alone or in the form of a mixture, are

a) alkali metal salts, alkaline earth metal salts, and ammonium salts (NH<sub>4</sub><sup>+</sup>), primarily the potassium salts and also the sodium salts, with inorganic or organic anions such as alkali metal halides, hydroxides, carbonates, hydrogen carbonates, alcoholates, and alkali metal salts of organic monocarboxylic acids. By way of example, there may be mentioned potassium fluoride, potassium iodide, potassium hydroxide, potassium carbonate, potassium hydrogen carbonate, potassium methylate, potassium ethylate, potassium *tert*-butylate, and potassium acetate;

b) ammonium salts and preferably phosphonium salts having at least one organic group in the cation and containing inorganic or organic anions,

primarily the halides, hydrogen carbonates, and acetates of such phosphonium salts in particular those containing three  $C_1$ - $C_4$  alkyl and/or phenyl groups, such as tri-*n*-butylphosphonium acetate and triphenylphosphonium chloride;

- 5 c) phosphines having at least one but preferably three C-organic radicals, in particular those selected from the group comprising  $C_1$ - $C_{10}$  alkyl,  $C_6$ - $C_{15}$  aryl,  $C_6$ - $C_{15}$  alkylaryl, and/or  $C_7$ - $C_{10}$  arylalkyl, such as, primarily tri-*n*-butylphosphine and triphenylphosphine; or
- 10 d) tertiary amines, preferably heterocyclics having from one to three N atoms as hetero atoms, such as, primarily, imidazoles, particularly *N*-( $C_1$ - $C_4$  alkyl)imidazoles such as *N*-methylimidazole, and also triazoles, pyridines, and bicyclic azaheterocyclics such as 1,8-diazabicyclo[5.4.0]undec-7-ene and 1,4-diazabicyclo[2.2.2]octane.

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Preferred catalysts are those which are mentioned under (a). Of this group, the potassium salts are preferably used and, more preferably, potassium fluoride or potassium hydrogen carbonate.

- 20 The catalyst, primarily the inorganic alkali metal salts and the alkali metal salts of carboxylic acids, can be bonded to a support, if desired. Examples of suitable supports are aluminum oxide, silica gel, and kieselguhr. The amount of catalyst in these supported catalysts is usually from 10 to 50 wt%.

- 25 The catalysts are usually employed in an amount of from 5 to 30 mol% preferably from 5 to 20 mol% and more preferably from 5 to 10 mol%, based on the ketoxime II.

- 30 The reaction can be carried out in a single, preferably aprotic, organic solvent or in a solvent mixture. However, the process is preferably carried out without the use of a solvent, in which case an excess of the carbonate IV can, in particular, serve as reaction medium.

- 35 Suitable solvents are alkylbenzenes, such as, in particular, toluene and also the xylenes, furthermore dialkylketones such as methyl ethyl ketone, halobenzenes such as chlorobenzene, and ethers such as 1,4-dioxane.

- The amount of solvent used is usually from 1 to 9 times, and in particular from 2 to 7 times, the weight of the ketoxime II. If the amount of solvent exceeds 9 times  
40 the weight of the ketoxime II, conversion and yield usually fall.

The addition of a phase transfer catalyst usually leads to an increase in reaction rate and conversion.

Suitable phase transfer catalysts are quaternary ammonium or phosphonium salts, preferably tetraalkylammonium, tetraalkylphosphonium, trialkylbenzylammonium, or trialkylbenzylphosphonium salts. Particularly preferred salts are the triethylammonium, tributylbenzylammonium, and tetrabutylammonium chlorides, bromides, and hydrogen sulfates, and also tributylhexaphosphonium bromide.

The phase transfer catalyst is usually employed in an amount of from 0.5 to 2 mol% and preferably from 0.7 to 1 mol%, based on the ketoxime II.

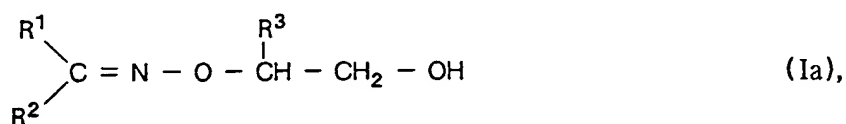
The reaction can be carried out batchwise or, preferably, continuously.

The reaction is preferably carried out at temperatures of from 80° to 150°C and mostly from 100° to 140°C and pressures of from 0.5 to 1 bar and especially under standard pressure.

The reaction times are normally from 8 to 24 h but mostly from 8 to 16 h.

The isolation of the reaction product I takes place by methods known *per se*, preferably by distillation.

The reaction frequently also produces, as by-product, the regioisomeric compound Ia



which is usually obtained in amounts of up to 10 %, based on I. The two isomeric compounds I and Ia are normally the first overheads occurring during distillation of the crude product. If desired the isomer Ia, which is undesirable for some applications, can be substantially separated from the compound I by methods known *per se*, preferably by fractional distillation.

The distillation residues of the crude mixture contain substantially unconverted carbonate IV and the catalyst.

In a preferred embodiment of the process of the invention the process is carried

out by replenishing the ketoxime II and the carbonate IV at a rate equal to the rate of consumption thereof, following the distillation of the product I from the reaction mixture, and the reaction is then repeated.

5 It has been found that in up to 20 successive reactions carried out in this manner in the same reactor, the yield of the compound I falls inappreciably and the ratio of the isomers I and Ia remains approximately the same.

The end products are suitable as precursors for herbicides of the cyclohexenone  
10 type (cf the prior *German Application* P 44 15 887.4).

### Examples

#### Example 1

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Preparation of *O*-(2-hydroxypropyl)propane-2-one oxime (process variant (a))

2.92 kg (40 mol) of acetone oxime were dissolved in 5.2 L of dimethyl formamide and admixed with 0.2 kg (2 mol) of triethylamine. This mixture was heated to 70°C  
20 in an autoclave well purged with nitrogen gas. Over a period of 4 h, 2.56 kg (44 mol) of propylene oxide were metered in at this temperature, and on completion of the addition, the reaction was allowed to continue for a further 3 h at 70°C.

25 The autoclave was then depressurized, and unconverted propylene oxide was extensively removed at 200 mbar and 70°C, by distillation.

During purification, by distillation, of the crude mixture with the aid of a column having a length of 50 cm and a diameter of 5 cm and packed with 3 mm V<sub>2</sub>A gauze  
30 rings, 2.84 kg of a mixture of *O*-(2-hydroxypropyl)propane-2-one oxime and *O*-(2-hydroxy-1-methylethyl)propan-2-one oxime were obtained at 78-81°C/30 mbar. The percentage isomer ratio determined by gas chromatography was 96:4.

#### Example 2

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Preparation of *O*-(2-hydroxybutyl)propan-2-one oxime (process variant (a))

Example 1 was repeated except that butylene-1 oxide was used instead of propylene oxide. During fractional distillation of the crude product, a mixture of *O*-  
40 (2-hydroxybutyl)propan-2-one oxime and *O*-(2-hydroxy-1-ethylethyl)propan-2-one oxime was obtained at 80-82°C/20 mbar in a yield of 59 %. The isomer ratio

was 96.7:3.3.

### Example 3

#### 5 Preparation of *O*-(2-hydroxypropyl)cyclohexanone oxime (process variant (a))

Example 1 was repeated starting from cyclohexanone oxime instead of acetone oxime. During fractional distillation of the crude product a mixture of *O*-(2-hydroxypropyl)cyclohexanone oxime and *O*-(2-hydroxy-1-methylethyl)cyclohexanone oxime was obtained at 74°C/0.2 mbar in a yield of 54 %. The isomer ratio  
10 was 96:4.

### Example 4

#### 15 Preparation of *O*-(2-hydroxypropyl)propanone oxime (process variant (b))

585 g (8 mol) of acetone oxime, 4080 g (40 mol) of propylene carbonate, and 80 g (0.8 mol) of potassium hydrogen carbonate in 200 g of toluene were caused to react for a period of 8 h at 130°C. There followed fractional distillation of the  
20 reaction mixture.

The fraction of desired product consisting of *O*-(2-hydroxypropyl)propane-2-one oxime and *O*-(2-hydroxy-1-methylethyl)propan-2-one oxime distilled over at 70-75°C/20-30 mbar in a percentage ratio of 92:8.

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Following cooling of the distillation residues, toluene, acetone oxime, and propylene carbonate were replenished to the aforementioned quantities and the reaction was then repeated. Following further 10 reactions of the type just described, an average was taken over all 12 reactions. The yield of *O*-(2-hydroxyalkyl) oximes  
30 was found to be 90 % based on acetone oxime.

### Example 5

#### Preparation of *O*-(2-hydroxypropyl)propanone oxime (process variant (b))

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The process was carried out as in Example 4 but without the addition of toluene. Starting from 344 g (4.7 mol) of acetone oxime, 2420 g (23.5 mol) of propylene carbonate, and 47 g (0.47 mol) of potassium hydrogen carbonate there was obtained, in a total of 10 reaction cycles carried out, in each case, for a period of  
40 8 h at 130°C, a mixture consisting of *O*-(2-hydroxypropyl)propane-2-one oxime and *O*-(2-hydroxy-1-methylethyl)propan-2-one oxime in a percentage ratio of

92:8 and at a yield of 89 %.

### Example 6

#### 5 Preparation of *O*-(2-hydroxypropyl)propanone oxime (process variant (b))

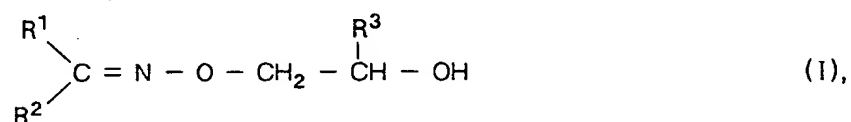
The process was carried out as in Example 4 but with the addition of 1086 g of toluene. Starting from 585 g (8 mol) of acetone oxime, 2450 g (24 mol) of propylene carbonate, and 80 g (0.8 mol) of potassium hydrogen carbonate there was  
10 obtained, in a total of 5 reaction cycles carried out, in each case over a period of 8 h at 125–130°C, a mixture consisting of *O*-(2-hydroxypropyl)propane-2-one oxime and *O*-(2-hydroxy-1-methylethyl)propan-2-one oxime in a percentage ratio of 92:8 and at a yield of 89 %.



## Preparation of *O*-(2-Hydroxyalkyl) Oximes

### *Abstract of the disclosure:*

5 Preparation of *O*-(2-hydroxyalkyl) oximes of the general formula I



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(R<sup>1</sup> and R<sup>2</sup> are alkyl or R<sup>1</sup> and R<sup>2</sup> and the C atom to which they are attached is 5-membered to 7-membered cycloalkyl; R<sup>3</sup> is alkyl) by causing a ketoxime II to react with an olefin oxide III in the presence of a tertiary amine or with a carbonate IV in the presence of a catalyst.

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The end products I are suitable for use as intermediates for herbicides of the cyclohexenone type.